

SCIENCE.

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IT has become a commonplace that the most abstruse researches may by a sudden twist acquire an eminently practical bearing. The actuary of an insurance company bases his computations on the calculus of probability, the X-ray specialist avails himself of a physicist's discovery made without thought of useful application, an up-to-date farmer is dependent on soil chemistry. But notable as such influences on life have been, they appear even in their totality almost trivial as compared with the influences, real and potential, exerted since half a century ago by the course of biological thinking. The applications of physics and chemistry have indeed assuaged suffering and added enormously to human comfort. But they have not revolutionized the world-view of the educated laity after the manner of Darwin's doctrine, nor do they imply a complete abandonment of old ethical conceptions and novel schemes for the rearrangement of society as radical as Plato's, such as were hatched or at least prefigured by Darwin's successors. Two of these stand pre-eminent in their influence on modern sociological theory—Weismann and Galton. It may be safely asserted that the whole of neo-aristocratic philosophy, so far as it has not a purely temperamental basis, rests on the pillars of Weismann's and Galton's views on heredity and of Galton's conception of individual variability. Not that the "scientific" neo-aristocrat has founded his principles on an objective study of biological facts. Quite the contrary. His biologizing is an afterthought, a "rationalization," as the Freudians would say, by which he seeks to justify personal predilection and prejudice. But in order to understand and to thwart his propaganda it is indispensable to turn to his scientific mainstays, and that is a far from unprofitable task. For, say what one will in criticism, Weismann and Galton were men of lofty intellectual stature and are well worthy of consideration on their own account. As to Weismann, comprehension of his work has been brought within the reach of the general public by a masterly exposition that has recently reached this country. Within the narrow compass of less than three hundred pages¹ the anatomist Ernst Gaupp succeeds in describing the development of his hero's philosophy of the organic kingdom through all its meanderings as he amplified and adapted it to embrace novel discoveries. Thus we gain a picture of an historically significant system of biological thought and also of an interesting and typical scientific personality.

For many years Weismann shared with Haeckel the honour of leadership among German Darwinians. The two men differed widely in their interests, their methods, their scientific views. Haeckel was absorbed in the task of tracing relationships between animal types and establishing their pedigrees. Weismann paid little attention to genealogies of species, but concentrated his efforts on the basic processes of organic existence—the nature of death, the mechanism of inheritance, the cause of variability. Haeckel, the Hotspur prophet of the evolutionary faith, bore the brunt of the fighting with the hosts of darkness, ruffling not a few sensibilities, yet gaining countless followers by the ardour of his preaching. More reserved in expression, though far from averse to

polemics, Weismann made his appeal to a smaller, more academic discipleship; and as zoological fashion veered from comparative anatomy and palæontology to the study of heredity he became in larger and larger measure the leader of the professionals. In the course of time, Weismann's attitude toward certain fundamental principles of evolution came to differ from Haeckel's, and from Darwin's as well. The difference lay in his estimate of the rôle of natural selection as a factor in evolution. Darwin had of course, himself, together with Wallace, thrust this principle into the arena of scientific discussion. But Darwin never wholly discarded as a complimentary cause the principle elucidated by Lamarck. His French predecessor had started from what everyday experience put beyond the possibility of doubt, the influence of use or disuse in strengthening or weakening an organ; but he taught further that the effects of such alterations in the individual's make-up could be transmitted to his offspring. The blacksmith, according to this theory, could not only improve his muscle by constant exercise, but his son would profit thereby and start at an advantage as compared with his father. It is clear why this assumption should find favour, for it gave a ready explanation of progressive development or, in the case of disuse, of atrophy and degeneration. But Weismann, in the later period of his thinking came to deny the value of the Lamarckian factor and fell back on natural selection as the sole and wellnigh omnipotent principle of evolution. Finally, while as far as ever from restoring Lamarck's conception to a place of honour, he came to supplement natural selection by a corresponding struggle among the minute particles making up the reproductive cells. In this psychic development of Weismann the feature of scientific and social significance was the critique of Lamarck, while the peculiarities of his mentality are best revealed by his speculations on the microcosm of the germ-plasm.

The notion that a trait acquired during the lifetime of an individual is bequeathed to his progeny not only serves the purpose of explaining how species have evolved but has in addition an extraordinary *a priori* plausibility. Thus primitive myths are full of Lamarckian interpretations. When the aborigines of America are impressed with a spot on the cottontail rabbit's body, they derive it from some adventure of an ancestor of the species, say from a firebrand he once carried in the course of a Promethean exploit. But before Weismann this was not an exclusively aboriginal mode of explanation. True, Galton had anticipated Weismann by a decade or so in challenging the generally accepted doctrine, but it was Weismann who systematically exposed the fimsiness of the alleged evidence and systematically offered alternative interpretations for phenomena that seemed unintelligible without recourse to Lamarck's conception.

Perhaps one of the strongest psychological arguments adduced by Weismann was the one that sapped the plausibility of the older explanation. It is clear that with species in which there is a differentiation of sex any trait can be inherited only through the reproductive cells of the parents, the father's sperm and the mother's egg-cell. If, then, an experience acquired by the parent is to be transmitted to the child, it implies that the exercise or disuse of the part in question somehow came to alter the reproductive substance. But it means more: the individual experiences must not only influence the germ-cell but must affect it in so definite a way that the offspring

¹ "August Weismann: Sein Leben und Sein Werk." Ernst Gaupp. Jena: Fischer.

developing from the germ shall copy precisely the alteration produced in the parent. But how such *specific* change in the germinal substance can be brought about is quite inconceivable. "How," asks Conklin, "could defective nutrition, which leads to the production of rickets, affect the germ-cells, which contain no bones, so as to produce rickets in subsequent generations, although well nourished? Or, how could overexertion, leading to hypertrophy of the heart, so affect the germ-cells that they, in turn, would produce hypertrophied hearts in the absence of overexertion, seeing that germ cells have no hearts?" The argument is unanswerable. Yet "inconceivable" is a highly subjective term, and it has happened more than once that what the sages pronounced as impossible nevertheless turned out to be true. Weismann wisely did not content himself with *a priori* considerations, but began to experiment and to analyse the alleged cases of Lamarckian inheritance.

First of all, there were the supposed instances of inherited mutilations. Before Weismann launched his attack on the Lamarckian theory, reputable naturalists believed that an injury in the parent might produce a corresponding injury in the descendants. Short-tailed sheep, for instance, were supposed to derive their peculiarity from a disfigurement of their progenitors. But Weismann pointed out that the causal nexus assumed was fictitious: breeders of a certain variety of sheep have regularly docked their tails for over a century, yet in not a single instance did the mutilated animals give birth to tailless offspring. This is all the more remarkable because another variety of sheep exists that is characterized by hereditary taillessness: in other words, the trait does not lie beyond the potentialities of the species, but it can not be induced by *mutilation*. Weismann himself conducted a long series of experiments with mice; for twenty-two generations he lopped off the tails of his subject but of 1592 mice born of these artificially disfigured parents not a single one lacked a tail. The deformations practised by various peoples for æsthetic or religious purposes since time immemorial form another case in point. The children of Indians accustomed to sever a finger joint in mourning are born with unamputated hands; those of East African Negroes who perforate the lobe of the ear have normal ears; circumcision has produced no hereditary result among the numerous Australian, African and Asiatic peoples with whom it is an indispensable preliminary to marriage. As a result of Weismann's powerful argumentation, probably no reputable biologist still believes that injuries can be transmitted by heredity.

Equally convincing was the demonstration of cases that were not possibly amenable to the Lamarckian interpretation. How, asks Weismann, can the spines shielding an acacia be the result of use? The tree rarely has occasion to avail itself of this armour, and even if some hungry ruminant should rub against it, not more than a few of the spines could possibly be affected thereby. Indeed, use is wholly excluded whenever certain instinctive activities are performed but a single time during the individual's life, as in the case of the queen bee's nuptial flight. Again, what shall be said of the extremely complicated adaptation of the worker ants? None of the peculiarities that distinguish these from their parents can be transmitted, for the reason that the workers are incapable of reproduction; hence must die without issue that might inherit the effects of their experience.

These are capital points absolutely crushing all

opposition, so far as they go. Yet it would be going too far to assert that Weismann has given a rigid demonstration establishing the impossibility of the transmission of individual experience to later generations. What he may fairly be credited with having accomplished is to rule out definitely a vast number of cases for which the Lamarckian factors had lightly been assumed. By so doing he whetted the critical sense of students and raised the standards of evidence exacted for the reality of these principles. In consequence the majority of living biologists reject as inadequate all the proofs hitherto adduced for the inheritance of acquired characters. But this position should not degenerate into an attitude of dogmatic scepticism. When the pupa of certain butterflies is subjected to abnormal cold the adult displays unusual colouration that often reappears in the descendants, though these are raised under normal temperature. With his customary resourcefulness Weismann explains the phenomenon in consonance with his general theory. This is not inheritance of the acquired colouring, he contends: the cold has not produced a primary effect on the body of the pupa, which was reflected on the germ-cells and led to a corresponding change in the offspring, but the cold simultaneously affected both the pupa and the germ-substance embedded in it. This, we must admit, is a very neat dialectic thrust, but it is not a proof. How does Weismann *know* that the germ-cells have been directly affected by the abnormal cold? What can be legitimately conceded is the possibility of squaring the facts with his system; but that is very different from saying that his theory has been definitely established for all cases, to the exclusion of all rival assumptions.

It is necessary to indicate the real logical status of the problem because many biologists make a shibboleth of the denial of the inheritance of acquired traits, as though such inheritance were not merely improbable and unproved, but veritably a contravention of all laws of thought. It is further necessary because of those momentous practical consequences that flow from an unconditional acceptance of Weismann's doctrine. No one has urged these more forcibly than Professor Pearson in "The Grammar of Science." Applied to the human species, Weismann's theory means that the effects of special training are *nil* so far as any initial advantage of later generations is concerned. "From a bad stock can come only bad offspring, and if a member of such a stock is, owing to special training and education, an exception to his family, his offspring will still be born with the old taint." Hence follows the demand for checking the increase of inferior stocks and promoting the multiplication of good stocks. Thus legislation affecting the weal and woe of thousands may be the direct outcome of Weismann's views. But this theory is, after all, built on probability rather than on certainty.

Though Weismann's historic importance for both biology and sociology lies in his attack on the Lamarckian principle, the salient features of his mental make-up appear more clearly in that conception of heredity and variability with which his scepticism was indissolubly linked. To unfold that intricate scheme is impossible within the limits of a single article. Suffice it to say that consistently with his rejection of the transmission of inherited characters, Weismann assumes that the germ-cells are radically distinct from the remainder of the body. The body does not produce the "germ-plasm," it is the germ-cells that produce the body and produce other germ-cells

as well. When the fertilized egg prepares for the creation of a new organism, a certain part of its germ-plasm is not used up in the process of individual development, because it is segregated from the start to form the germ-plasm of the new individual. When one of these cells in turn becomes active in reproduction, the resulting individual must resemble his parent because both are merely products of the different parts of the same original plasm. Thus the germ-plasm is never created anew by the body, but only grows and multiplies like all living matter, and, to quote Conklin, remains "the continuous stream of living substance which connects all generations. The body nourishes and protects the germ; it is the carrier of the germ-plasm, the mortal trustee of an immortal substance."

Weismann peopled the germinal substance with a throng of living units far beyond the power of the strongest microscopes. The smallest of these minute particles are grouped together into "determinants" which are not, indeed, miniature replicas of the corresponding parts of the adult organism, yet definitely determine them. As natural philosophers have explained physical phenomena by a dance of atoms, so Weismann came to conceive variability as the consequence of competition among his minute molecular mess-mates. Through the chance disposition of nutritive matter one determinant will thrive and develop, while its neighbours may languish away, thus causing corresponding alterations in the adult organism.

In contemplating Weismann's comprehensive scheme, of which the foregoing are merely typical samples, one is tempted to say, "It's pretty, but is it science?" The answer will inevitably depend on one's scientific taste. If science is a description of empirical phenomena, if no speculation is admissible that can not be put directly to the test of observation, then to picture in detail the workings of an avowedly invisible microcosm must be reckoned a play of the imagination that has nothing to do with the pursuit of reality. From this point of view, Weismann appears frequently not as a scientist but as a metaphysician and a poet—a metaphysician in his attempt to elaborate a closed logical system, a poet because of the concreteness with which he endows the creatures of his fancy. But there is a psychological aspect to the case that can not be ignored. Scientists, we must ever remember, differ vastly in the character of the driving force that compels their highest efforts. One type of mind finds its highest satisfaction in grappling with facts directly amenable to observation, in formulating a provisional generalization on this basis and subjecting it to immediate and incessant verification. But not all investigators conform to this standard. Some there are who can not rest content with studying what to them seems the mere surface of things, but who are impelled to divine their inner nature, however far removed from the possibility of demonstration. While gratifying this aspiration they are often able, incidentally, to accomplish or to stimulate others to accomplish notable results of a more tangible character, or to suggest points of view that remain for decades in the foreground of discussion. To this category Weismann manifestly belongs. He can not fairly be compared with men of the other category, because these types are incommensurable. But in his own class, his rank must ever be a high one because of the numerous fertile ideas he has contributed for the elaboration of evolutionary theory.

ROBERT H. LOWIE.

MISCELLANY.

ONE of the hope-inspiring facts of life is that thoughtful people are to be found everywhere. At the Plaza one noon I noticed a man at luncheon laying down the law to his two table-companions, one of whom was a young woman of foreign appearance. "Go back," he said, with great emphasis, "and tell Rolland and Barbusse that there can be no such thing as they dream of, no great, free fellowship in literature and the arts, 'until the economic fundamental is established.'" Two days later, at dinner in the Gotham, I overheard one of a small party near me, a prosperous-looking man, apparently a man of affairs, raise the desponding question, "How is it that, all over the world, Governments are proving themselves enemies of the people?" It seemed odd to hear such doctrines broached in these places. A day or two afterwards, in an Armenian restaurant on Lexington Avenue, I heard a young man and a young woman speculating very sensibly about the prospect of a gigantic collapse of credit and industry. Then next day, as the keeper of a shabby little cigar-shop on Sixth Avenue handed me a small purchase, he said, "Didja see what that guy over in France is tryin' to do, breakin' up the labour-unions? Ain't that the rottenest thing y'veer heard of?" Mostly fools, perhaps—Carlyle may have been right, but I think Cervantes was nearer the mark when he said, "The mountains breed learned men, and philosophers are found in the huts of shepherds."

THE latest scene in the passing of the sceptre of monarchy has been staged by the Danish importer who has just purchased the household furniture of the ex-Kaiser. This thrifty merchant, seeking a suitable market for his wares—"three complete salon sets from two royal palaces in Berlin and another in Munich," explains the *New York Sun* with great relish—very properly and naturally is bringing them to the United States. No doubt they will promptly be acquired by Mr. Gary or Mr. Morgan or some other of our barons of empurple privilege, in any of whose spacious palaces they will soon feel pleasantly at home. But is it not in order to suggest that a grateful country should purchase this furniture by popular subscription and give it to Mr. Wilson for the furnishing of his new home when he moves next year?

PROBABLY there are available statistics indicating the relative popularity of American cities as meeting-places for large conventions. Every profession, trade and social activity is organized, and every organization meets at least once a year. I have attended many more conventions outside New York than in that city, and I have found that, though outsiders prefer New York, as a rule, because it enables them to kill several birds besides the business of the meeting, New York is not often an eager applicant for the honour of entertaining visiting delegations. There may be several reasons for this. The metropolitan hotels are usually filled to capacity at exorbitant prices, with the normal rush of buyers and sight-seers at the convention season, hence are reluctant to tempt organizations with special cut-rates. The business men upon whom the arrangements might devolve are not ready to make sacrifices for the necessary preparations, and for the entertainment of visiting delegates, because they know that the important ones will come to New York anyhow and will absorb entertainment from the wealth that lies at every hand without adhering to such programmes as are inevitable in other cities.

LET a trade organization numbering 300 meet for three days at a New York hotel; the members go about, wearing their badges and, so long as they remain within the hotel they are proudly conscious of themselves as an entity. Once they trickle out on Broadway they are lost in the whirlpool. In a few minutes they protect them-